San José State University
Computer Science Department
CS276 Section 2, Machine Learning on Graphs, Fall 2023

Course and Contact Information

Instructor:	Aikaterini Potika
Office Location:	MacQuarrie Hall 215
Telephone:	408-9245134
Email:	katerina.potika@sjsu.edu
Office Hours:	Mondays-Wednesdays 9:30-10:00 am and Mondays 12-1 pm or by appointment
Class Days/Time:	Mondays-Wednesdays 10:30-11:45 am
Classroom:	MacQuarrie Hall 225
Prerequisites:	CS 146 (with a grade of "C-" or better in each); or instructor consent.

Course Format

Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on Canvas Learning Management System course login website at http://sjsu.instructure.com. You are responsible for regularly checking with the messaging system through MySJSU at http://my.sjsu.edu (or other communication systems as indicated by the instructor) to learn of any updates.

Course Description

Graphs are a powerful way to model networks. Networks contain a plethora of valuable information about the underlying data of various scientific fields. Students are introduced to various network analysis and machine learning techniques to help them extract, analyze and visualize networks.

Course Learning Outcomes (CLO)

Upon successful completion of this course, students will be able to:

- **CLO1** Select techniques for analyzing complex networks.
- **CLO2** Recognize and compute network properties and features, like node centralities, similarities, graphlets, and graph kernels.
- **CLO3** Integrate machine learning techniques, like clustering and classification, for graph problems.
- **CLO4** Create and use deep learning techniques for graph, node, and edge problems.

Required Texts/Readings

Textbooks recommended

Graph Representation Learning, by William L. Hamilton

Networks, Crowds, and Markets: Reasoning About a Highly Connected World, by David Easley and Jon Kleinberg, Cambridge University Press, ISBN-13 978-0521195331

Network Science by Albert-László Barabási, Cambridge University Press, ISBN-13 978-1107076266

Introduction to Machine Learning with Applications in Information Security by By Mark Stamp, 2nd edition, Chapman & Hall, ISBN-13 978-1032204925

Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT press, ISBN-13 978-0262035613

Knowledge Graphs: Fundamentals, Techniques, and Applications, by Mayank Kejriwal, Craig A. Knoblock and Pedro Szekely, MIT press, ISBN-13 978-0262045094

Online resources: paper, tutorials.

Course Requirements and Assignments

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course-related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.

Final Examination or Evaluation

Faculty members are required to have a culminating activity for their courses, which can include a final examination, a final research paper or project, a final creative work or performance, a final portfolio of work, or other appropriate assignments.

Homework assignments: individual, regularly assigned will include written problem assignments, and perhaps some online exercises. Solutions will not be posted. The homework is a tool for you to learn the material and prepare for the exams.

Reading assignments: Reading assignments will regularly be for the next class (see schedule).

Quizzes: Unannounced quizzes may be given during class, each of 10 minutes total. These will generally be problems from the reading assignment and/or the homework.

Class notes and Activities: In-class note-taking of a topic, writing a small report, and hands-on examples of the problems and methods we cover using various datasets.

Group Project: A programming project of your choice related to the course's topics in groups of no more than three students. Never use any code you find on the web unless given by me. The penalty for late submission is 5% for every 3 days up to 9 days, after that no submission will be accepted. The final presentation at the end of the semester is mandatory.

Participation: In-class participation and activities, online polls etc.

Midterm exam: There will be one written Midterm exam during the semester.

Final exam: One written final exam.

The exams will contain multiple-choice questions, short answer questions and questions that require pseudocode and/or computations.

Grading Information

Determination of Grades

Final Grade:
25% Project
10% Homework
10% Participation & Discussions
15% Quizzes
10% Class notes and activities
15% Midterm
15% Final

The final exam is comprehensive.

Grade	***Percentage***
A plus	96 to 100%
A	93 to 95%
A minus	90 to 92%
B plus	86 to 89 %
B	82 to 85%
B minus	78 to 82%
C plus	74 to 77%
C	70 to 73%
C minus	65 to 69%
D plus	62 to 64%
D	58 to 61%
D minus	55 to 57%
F	<54%

Classroom Protocol

Attendance is highly recommended. Please avoid disturbing the class: turn-off cell phones (or put them on vibrate mode), no text messaging in the class or the exams, **no taking pictures and video**, avoid coming late. You may not publicly share or upload material for this course such as exam questions, lecture notes, or solutions without my consent.

University Policies

Per University Policy S16-9 *(http://www.sjsu.edu/senate/docs/S16-9.pdf)*, relevant information to all courses, such as academic integrity, accommodations, dropping and adding, consent for recording of class, etc. is available on Office of Graduate and Undergraduate Programs' Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/".

CS276: Machine Learning on graphs, Fall 2023

The schedule is subject to change with fair notice and how the notice will be made available

Lesson	Date	Topic	Reading/Projects (part of chapters covered)
1	8/21	Introduction	
2	8/23	Motivation and problems	
3	8/28	Graphs review	
4	8/30	Graph algorithms for Network Science	
	9/4	Break	
5	9/6	Network Science tools	Homework 1 out
6	9/11	Node statistics	
7	9/13	Edge statistics	
8	9/18	Graph statistics	
9	9/20	Traditional ML approaches basics	
10	9/25	Traditional ML approaches on graphs	
11	9/27	Deep Learning basics	Homework 1 due
12	10/2	Natural Language Processing and graphs	Project proposal

13	10/4	Representation learning	Homework 2 out
14	10/9	Random walks	Homework 2 out
15	10/11	Node, edge, and graph representations	
16	10/16	Graph Neural Networks message passing	
	10/18	**Midterm**	
17	10/23	Graph Neural Networks neighborhood aggregation	
18	10/25	Graph Neural Networks applications	Project demo
19	10/30	Link analysis and web search	Homework 2 due
20	11/1	Community detection	Homework 3 out
21	11/6	Hierarchical graph representation	
22	11/8	Influence maximization	
23	11/13	Recommender systems	
24	11/15	Knowledge graphs embeddings	
25	11/20	Knowledge graphs problems	
	11/22	**Break**	
26	11/27	Random graphs	Project presentations due
27	11/29	Graph Generation	Project due
28	12/4	Project presentations	Homework 3 due
29	12/6	Project presentations	
		Final exam Tuesday, December 12 9:45 AM-12:00 PM	